ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.

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27 September 1973

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: Dr. Vincent V. Salomonson
ERTS Scientific Monitor, Code 651

Subject: ERTS-A Investigation No. SR201: Evaluate the Application of ERTS-A Data for Detecting and Mapping Snow Cover

Principal Investigator: James C. Barnes, PR011

Gentlemen:

This is the fifth bimonthly Type I Progress Report describing work performed by Environmental Research & Technology, Inc. (ERT), for the National Aeronautics and Space Administration under Contract No. NAS 5-21803. This report covers the period from 10 July to 10 September 1973.

The purpose of this investigation is to evaluate the application of imagery from the ERTS-A RBV and MSS sensors for snow survey. The objectives are: to determine the spectral interval most suitable for snow detection and mapping; to determine the accuracy with which snow lines can be mapped in comparison with the accuracies attainable from other types of measurements; and to develop techniques to differentiate reliably between snow and clouds, to attain accurate geographic referencing, and to understand the effects of terrain and forest cover on snow detection. The results will demonstrate the advantages and limitations of spacecraft high-resolution, multispectral measurements for snow survey and will provide the analyst with interpretive techniques that will enable the maximum use of data from ERTS and future spacecraft systems.

A. ACCOMPLISHMENTS DURING REPORTING PERIOD

During this reporting period the snow extent in the southern Sierra Nevada has been mapped for two additional dates late in the snowmelt season. The dates are 12 and 30 June. The snow extent mapped from the 12 June imagery is being compared with the aerial snow survey chart for 11 June, the final

chart of the season prepared by the Corps of Engineers. No correlative snow measurements exist for the late June case; however, analysis of the 30 June imagery gives an indication of the magnitude of the snow line retreat during that 18-day interval. ERTS imagery for the Kern Basin on 7 May was also received recently and is in the process of being analyzed; imagery for the other three basins of the southern Sierras on 8 May had been analyzed previously.

Additional aerial snow survey charts for the Salt-Verde Watershed were received during this reporting period. These charts (for 26 March, 12 April, and 27 April) are nearer the dates of the ERTS data (26 March, 13 April, and 2 May, respectively) than were the charts that had been available previously. Comparative analyses using the recently received charts are in progress.

Late in the reporting period, the color composite positive transparencies that had originally been requested from the NDPF last April were received. The total color composite data sample consists of imagery for the following areas: nine dates for the Sierra Nevada, from 16 September to 26 May; four dates for the Salt-Verde Watershed, from 21 November to 26 March; and five dates for the Black Hills area from 6 December to 6 March. The color composites are now being examined to determine whether color products can be useful for snow mapping and, in particular, for snow detection in forested areas. The initial examination of two color transparencies for the Arizona test site had indicated that color products may have some advantages for snow detection and mapping. In those color transparencies, water features such as lakes, reservoirs, and rivers could be more readily identified, as could vegetation areas and the location of the tree line. In the forested areas, the snow appeared to be more discernible than it is in the single-band data products. The preliminary examination of the color data for the heavily forested Black Hills, however, does not indicate any outstanding differences in comparison with the black and white data products.

Analysis of the ERAP high-altitude aircraft data collected for the Sierra Nevada and Salt-Verde Watershed has continued. For portions of these areas, detailed maps showing the snow line derived from the aircraft photography and from the corresponding ERTS image have been prepared. These maps demonstrate the scale of the snow features that can be detected in ERTS imagery.

B. PLANS FOR NEXT REPORTING PERIOD

During the next reporting period the investigation of the application of ERTS data for snow mapping will be concluded. All analyses, including the analysis of the recently received color-composite data, will be completed. All analysis procedures, results, and conclusions will be documented in a final report to be submitted at the end of the reporting period.

C. PUBLICATIONS

During this reporting period, a paper resulting from the effort performed under the contract was prepared for presentation at the Symposium on "Management and Utilization of Remote Sensing Data," to be given the week of 29 October - 2 November 1973 at Sioux Falls, South Dakota.

D. PROBLEMS

No problems to impede the progress of the investigation are anticipated.

E. ERTS IMAGE DESCRIPTION FORMS

Image Descriptor Forms are attached to this progress report.

F. FUNDS

It is anticipated that the remaining funds will be adequate for successful completion of the investigation.

Very truly yours,

James C. Barnes

James C. Barnes
Principal Investigator

JCB:jm

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D _____
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ID _____

DATE 26 September 1973

PRINCIPAL INVESTIGATOR James C. Barnes

GSFC PR011

ORGANIZATION Environmental Research & Technology, Inc.

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	Snowpack	Mountains	Rivers	
1283-17332 MP	x	x	x	Roads, power lines, town, agriculture
1324-18011 MP	x	x	x	Lakes, airport, valleys.
1342-18010 MP	x	x	x	Cities, highways, reservoirs.

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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GSFC 37-2 (7/72)

DISCIPLINE: WATER RESOURCES, SNOW SURVEYS

TITLE: EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SNOW COVER (SR No. 201)

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DISCUSSION OF SIGNIFICANT RESULTS

Based on the results of the data analysis completed through this reporting period, it is concluded that the amount of information in ERTS imagery with practical application to snow mapping is substantial.

For the Arizona and California test sites, it appears that the extent of the mountain snowpacks can be mapped from ERTS data in more detail than is depicted in aerial survey snow charts. In the Salt-Verde Watershed, the agreement between the percentage of the area snow covered as measured from the ERTS data and from aerial survey charts is generally well within 10%. In nearly all of the areas in which greater discrepancies occur, the differences can be explained by changes in snow cover during the interval between the two observations. In the southern Sierra Nevada, the agreement between ERTS data and aerial survey charts is of the order of 5% in all cases, except for the Kaweah Basin on one date.

In addition to comparative analysis with aerial snow charts, the ERTS data have also been compared with high-altitude aircraft photography provided by the NASA/ARC Earth Resources Aircraft Project (ERAP). The ERAP data have provided an excellent source of correlative information. The results of the comparative analysis indicate that although small details in the snow line that cannot be detected in the ERTS data can be mapped from the higher resolution aircraft data, the boundaries of the areas of significant snow cover can be mapped as accurately from the ERTS imagery as from the aircraft photography.